FIELD TRIAL OF ABATE® AND TEKNAR® FOR *SIMULIUM* (DIPTERA: SIMULIIDAE) CONTROL IN INDIA

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ABSTRACT. *Simulium* breeding was eliminated in a river up to 30 km with 0.1 ppm Abate (temephos) for 30 min exposure. Teknar (*Bacillus thuringiensis* var. *israelensis*) at 10 ppm for 10 min exposure resulted in 98.4% and 87.9% reduction up to 20 m in 2 sections of a small stream.

In India the abundance of *Simulium* spp. (locally known as dimdam flies) and their biting nuisance is well known in the northeastern region (Perti 1963). During the early sixties, susceptibility of *Simulium* larvae to insecticides with small scale field trials using DDT and BHC were carried out in NEFA (North-East Frontier Agency—now Arunachal Pradesh) by Perti and Lopez (1964). Das et al. (1981) reported the susceptibility of *Simulium himalayense* Puri larvae to certain insecticides in this area.

Though *Simulium* or blackfly bites can be avoided by using selective insect repellents (Das et al. 1985), an effective control program must be based on larviciding the river systems. Temephos (Abate®) appears to be the larvicide of choice due to its biodegradable nature and low mammalian toxicity. In the present study the acute toxicity and carry of Abate[1] 500E and Teknar[2] (*Bacillus thuringiensis* var. *israelensis*, serotype H-14) were studied and compared with the available data of the conventional insecticide DDT to obtain a better understanding of their true utilization.

The study was carried out in 6 hill streams and a river of the Kameng district, Arunachal Pradesh, where an actual control program was warranted. This is the first report on the field evaluation of Abate and Teknar for *Simulium* control in India.

The discharge rate of the river and streams were determined by obtaining velocity of water by a pitot tube × depth × width (Hill 1959). The quantities of insecticide required were calculated on the basis of discharge rate and treatment time. The insecticide solutions were prepared in drums. A 15 liter capacity "dipping can" with a calibrated hole at the bottom was used to dispense the insecticide solution at the regulated rate. A convenient treatment time, i.e., 30 min, was selected as standard, which was increased and decreased to study the dose-time relationship for larval abatement.

To determine the pre- and posttreatment larval density, 10 polyethylene (=polythene) strips (25 × 1 × 0.2 cm) were fixed at each sampling site in the stream or river. Daily observations were taken on the number of larvae attached to the strips for at least 3 days before and after the treatment. Matured larvae were collected from each sampling site and examined to determine its species composition.

The larvae collected were 90% *Simulium himalayense* and the rest consisted of *S. baraudi* Puri, *S. kapuri* Datta, *S. praelargum* Datta and *S. striatum* Brunetti. The pH of the river and the stream water was 6.0, and the temperature ranged between 9 and 16°C.

Data collected during the field trials are summarized in Table 1.

Treatment with 0.05 ppm Abate for 30 min yielded 97.9% larval reduction up to 3 km in hill streams. However, "carry" of Abate was reduced at 5 km resulting in only 50.4% and 43% larval detachment. While at 0.1 ppm concentration, *Simulium* breeding was completely eliminated in 6 hill streams up to a maximum coverable distance of 5 km.

In the river, complete elimination of larval populations was observed up to 30 km with 0.1 ppm Abate. The "carry" of Abate reduced at 40 km, but was enough to induce 84.8% larval detachment.

An attempt has been made to establish the factor of dose-time relationship as suggested by Frommer et al. (1983). The treatment time was enhanced by lowering the dosage so that the quantity of larvicide used remained the same.

At 0.01 ppm concentration of Abate for 150 min (equivalent to 0.05 ppm × 30 min) and 180 min (equivalent to 0.06 ppm × 30 min), larval detachment was 23 and 47%, respectively. No larval detachment was observed at 0.02 ppm for 90 min (equivalent to 0.06 ppm × 30 min) and 120 min (equivalent to 0.08 ppm × 30 min).

Ten minutes treatment time was taken as the standard (due to high dosage) in case of Teknar. Treatment with 10 ppm yielded only 21.9 and 17.7% larval reduction up to 3 and 5 km, respectively. Even at 20 ppm reduction, the rate was marginally increased, e.g., 24.4%.

To study the dose-time relationship, 5 ppm Teknar was dispensed for 30 min (equivalent to 15 ppm × 10 min) resulting in only 18% larval

[1] 50% EC, American Cyanamid Co.
[2] No. SAN 402-1, Sandoz, USA.

Table 1. Field evaluation of Abate® and Teknar® for control of *Simulium* breeding.

Stream or river	Length of experimental section (km)	Discharge rate (m^3/sec)	Concentration (ppm)	Treatment time (min)	Larval density per 1,000 cm^2	±SD per strip	Larval reduction after 24 h (%)
I. Abate							
1. MES Dahung	3	0.18	0.05	30	1,834	7.0	97.9
2. Chindit	5	0.33	0.05	30	270	2.8	50.4
3. Chindit	5	0.22	0.05	30	1,348	17.5	43.0
4. Dukumpani	5	0.25	0.02	90	140	1.6	00.0
5. Dukumpani	5	0.25	0.02	120	35	2.2	00.0
6. Dukumpani	5	0.25	0.10	150	172	4.6	23.0
7. Chindit	5	0.22	0.08	30	79	3.8	84.8
8. Chindit	5	0.22	0.01	180	892	13.9	47.0
9. New Birpur	3	0.13	0.08	30	444	3.3	97.0
10. MES Dahung	3	0.18	0.09	30	2,302	27.5	100.0
11. Chindit	5	0.52	0.1	30	364	6.0	98.9
12. Rupa	4	1.84	0.1	30	258	2.2	100.0
13. Dukumpani	5	0.27	0.1	30	340	2.2	100.0
14. Engineers	2	0.07	0.1	30	1,492	13.8	100.0
15. New Birpur	3	0.23	0.1	30	482	6.3	100.0
16. Tenga river							
Sample site-1	5	9.5	0.1	30	264	2.8	100.0
Sample site-2	10	9.5	0.1	30	360	3.8	100.0
Sample site-3	20	9.5	0.1	30	246	5.7	100.0
Sample site-4	30	9.5	0.1	30	222	1.6	100.0
Sample site-5	40	9.5	0.1	30	66	1.5	84.8
II. Teknar							
1. MES Dahung	3	0.12	10	10	888	11.5	21.9
2. Chindit	5	0.22	10	10	340	4.0	17.7
3. New Birpur	3	0.13	20	10	516	9.5	24.4
4. Chindit	5	0.22	5	30	942	10.7	18.0
5. Chindit	5	0.22	1	150	958	12.1	30.0
6. Diary nala	0.02	0.0025	10	10	248	4.2	87.9
7. Diary nala	0.02	0.0025	10	10	368	5.6	98.4
8. Diary nala	0.15	0.28	5	30	554	5.9	67.0
9. Diary nala	0.15	0.28	1	150	177	2.6	82.0

detachment which was increased to 30% when treatment time was enhanced to 150 min with 1 ppm concentration (equivalent to 5 ppm × 30 min). In small streams, treatment with 10 ppm Teknar for 10 min resulted in 87.9–98.4% larval reduction at a distance of 20 m. At 5 ppm for 30 min, 67% larval detachment was observed up to 150 m, which was enhanced to 82% when the treatment time was further increased to 150 min with 1 ppm concentration (equivalent to 5 ppm × 30 min).

Present trials indicate that Abate is a better larvicide for control of *Simulium* breeding in northeastern India. Quelennec (1976) obtained complete elimination of *Simulium* breeding up to a distance of 32 km using 0.54 ppm Abate for 30 min. Present trials exhibit identical results using less than one-fifth of the said dosage. This may be due to the high susceptibility status of *S. himalayense* larvae.

The results of the present study with Abate are in conformity with the earlier 10 years field observation data from Africa recorded by Stiles and Quelennec (1977). The minimum threshold dosage recorded in the present study was found between 0.08 and 0.09 ppm for 30 min; however, good results were obtained with 0.1 ppm. In the case of very low dosage, the minimum treatment time required is above 150 min.

Frommer et al. (1981) observed 25% larval reduction after 24 h of treatment with 3.1 ppm *B.t.i.* for 30 min at a distance of 312 m which was increased to 50–70% with 1.55 ppm for 70 min. Lower dosage of Teknar (*B.t.i.*) with enhanced timings exhibited better results than high dosage and short duration treatment in the

present study also. This indicates the positive response of microbial insecticides to a dose-time relationship as observed by earlier workers. This lotic habitat of a slow stream seems to affect the "carry" and activity of *B.t.i.* which increases significantly in a fast flowing river. The "carry" and effectiveness of *B.t.i.* was recorded as far as 20 km in the Marahoué River (457 m^3/sec discharge) in the Ivory Coast (Lacey and Undeen 1986).

Dose-time relationship of Temephos/Abate for control of *Simulium* breeding has been studied in detail by Frommer et al. (1983) and Muirhead-Thomson (1983). Information is lacking, however, on the progressive decrease of concentration of insecticide with the increase in its period of impact downstream during field trials. We believe that the effect of a longer exposure period with lower dosage cannot be achieved by a reciprocal increase in the dosage in a short exposure period. In the present trial it has been observed that 30 min treatment time with an optimum concentration of 0.1 ppm Abate is ideal for undertaking an effective *Simulium* control program in the prevailing field conditions of India.

The carry of insecticides which is an important factor in *Simulium* control needs detailed field study "with lower-dosage-longer exposure period" which will help in laying out effective strategies in the Onchocerciasis Control Program.

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REFERENCES CITED

Das, S. C., M. Bhuyan, N. G. Das and K. M. Rao. 1981. Susceptibility of *Simulium himalayense* larvae to some insecticides. J. Commun. Dis. 13:189–193.

Das, S. C., M. Bhuyan, N. G. Das and P. R. Malhotra. 1985. Field trials on the relative efficacy of five repellents against *Simulium himalayense* (Diptera: Simuliidae). Indian J. Med. Res. 81:378.

Frommer, R. L., S. C. Hembree, J. H. Nelson, M. P. Remington and P. H. Gibbs. 1981. The evaluation of *Bacillus thuringiensis* var. *israelensis* in reducing *Simulium vittatum* (Diptera: Simuliidae) larvae in their natural habitat with no extensive aquatic vegetative growth. Mosq. News 41:339–347.

Frommer, R. L., J. H. Nelson, P. H. Gibbs and J. Vorgetts. 1983. Dose-time response between *Simulium vittatum* (Diptera: Simuliidae) larvae and Abate 200E (Temephos). Mosq. News 43:70–71.

Hill, G. 1959. Method of water-flow measurement applicable to *Simulium* control. Bull. W.H.O. 21:201–205.

Lacey, L. A. and A. H. Undeen. 1986. Microbial control of black flies and mosquitoes. Annu. Rev. Entomol. 31:265–296.

Muirhead-Thomson, R. C. 1983. Time/concentration impact of *Simulium* larvicide, Abate and its relevance to practical control programs. Mosq. News 43:73–76.

Perti, S. L. 1963. Dimdam nuisance and its control. Labdev J. Sci. Tech. 1:1–6.

Perti, S. L. and W. A. Lopez. 1964. Bionomics and control of *Simulium* flies in NEFA area. Part II and III. Armed Force Med. J. 20:180–193.

Quelennec, G. 1976. Field trials of new insecticide formulations for the control of black fly larvae. WHO/VBC/76. 612, 4 p.

Stiles, A. R. and G. Quelennec. 1977. Summary of field trials of candidate larvicides for control of *Simulium damnosum* in Africa, 1967 to 1976. WHO/VBC/77.667, 10 p.